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AUTOMATIC TRANSMISSION FOR MOTOR VEHICLES

[001]

[002]

[003]

The present invention concerns a motor vehicle transmission capable of automatic shifting, with three spider mounted, planetary sets, three braking mechanisms, two couplings for six forward gear changes and one reverse gear change as well as one input drive shaft and one output drive shaft.

[004]

A planetary transmission of this nature has been made known by US 4,070,927, wherein the number of the forward gears is respectively greater by one than the numbers of the frictional elements. At each gear change between the forward gears, one of the provided frictional elements is shifted in or out.

[005]

Automatically shifting vehicle transmissions for motor vehicles, which are made in planetary construction, have already been described in the state of the technology many times and are subject to ongoing development and improvement. Thus, these transmissions should possess a sufficient number of forward gears as well as one gear for reverse. Further, the said transmissions should have a gear ratio very well adapted to motor vehicles with a high over-all range as well as favorable intervening stages. Further, these should make possible a high start-up gear ratio in the forward direction and make available a direct drive advantageous for installation in both passenger cars as well as in commercial vehicles. Besides this, these transmissions should require small expenditure in manufacturing expense and especially favorable, is that they require a small number of shifting components. Advantageously, double shifting is avoided in sequential shifting, so that in the case of shifting within particular gear groupings, only one shifting component is changed.

[006]

Thus, the purpose of the invention is to make available a new and improved transmission, which avoids the known faults and yet fulfills the above mentioned advantages. Further the purpose will include a desirable construction and arrangement of a start-up element as well as make possible a desirable design of the input and output of power.

[007]

In accord with the invention, this purpose will be achieved by a transmission for a motor vehicle with automatic shifting capabilities of the type mentioned in the introductory passages with the features of Claim 1.

[008]

[009]

The automatically shiftable transmission for a motor vehicle with three spider mounted planet gears, three brakes and two clutches, assembled to shift into six forward gears and one reverse gear is so designed, that the drive shaft is connected directly with the sun gear of the second planetary set, and that the input drive shaft, by means of the first clutch, can be connected with the sun gear of the first planetary set and/or by the second clutch with the spider of the first planetary set. In addition, or alternatively, the sun gear of the first planetary set, by means of the first brake is connectable with the housing of the transmission and/or the spider of the first planetary set. By means of the second brake, the said sun gear can be connected with the said housing, and/or the sun gear of the third planetary set can be connected by the third brake with the housing.

[010]

In this way, an automatically shiftable vehicle transmission is available, with six forward gears, and one reverse gear which, advantageously for motor vehicles, exhibits a very well adapted gear ratio with a high over-all range and favorable gear change stages, as well as a high start-up ratio in the forward direction. Further the fifth gear is a direct gear. A transmission of this nature is adaptable both for passenger vehicles and for commercial vehicles and characterizes itself by a modest cost of construction, that is, two clutches and three brakes, wherein, in the case of sequential shifting, double shift is avoided and thus, with any desired shifting within a group of gears, respectively only two shifting elements are changed.

[011]

The transmission in accord with the invention can be made in an advantageous manner in two versions, wherein these versions differ from one another by the varying connections within the individual planetary sets. In the first version, provision is made, that the power take-off shaft is continually connected to the spider of the third planetary gear set and with the internal gear of the first planetary set. Provision is further made, in that the spider of the first planetary set is continually connected to the internal gear of the second planetary set and the spider of the second planetary set is continually connected with the internal gear of the third planetary set.

[012] The power input drive shaft and the power output drive shaft can, in this design, be coaxial with one another on opposite sides of the transmission housing as well as on the same side of the said transmission housing. Further, a placement of the power takeoff drive between the planetary sets and the clutches is possible.

[013] In a development in accord with a second version: the power takeoff drive is continually in connection with the spider of the second planetary set and with the internal gear of first planetary set; the spider of the first planetary set is continually in connection with internal gear of the third planetary set 4 , and the internal gear of the second planetary set is continually in connection with the spider of the third planetary set. A design of this kind is especially well adapted for a coaxial arrangement of power input and power take-off shafts.

[014] A development of the invention proposes, that the first clutch be activated in the first and fifth gear, as well as the reverse gear, and that the second clutch is activated in the fourth, fifth and sixth gear.

[015] The first brake is activated in the second and sixth gear, the second brake is available for the first and reverse gears and the third brake is activated in the first, second, third and fourth gear. In this way, the achievement is advantageously made, that each time, only one shifting element for each optional shift between the first and the fourth gear, between the third and fifth gear and between the fourth and sixth gear is changed. Thus, when sequential shifting is carried out, double shifting is avoided.

[016] Further goals, features, advantages, and application possibilities of the invention are made known from the following description of an embodiment example, which is more closely detailed by reference to the drawings.. In this way, all described and/or illustrated features, of themselves, or in optional, advantageous combination, form the object of the invention, independently from their condensation in the claims and the inter-references of said claims.

[017]

[018] There is shown in:

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- [019] Fig. 1 in schematic presentation, a transmission with coaxial power input and output in accord with a first version,
- [020] Fig. 2 in schematic presentation, a transmission with coaxial power input and output in accord with a second version,
- [021] Fig. 3 in schematic presentation, a transmission in accord with the first version with the power input on the power output side,
- [022] Fig. 4 in schematic presentation, a transmission in accord with the first version, with power output between the planetary sets and the clutches,
- [023] Fig. 5 in schematic presentation, a transmission with a torque converter for a standard transmission assembly,
- [024] Fig. 6 in schematic presentation, a transmission in accord with the first version, however, in mirror image arrangement with integrated start-up braking for a front-cross-arrangement in passenger car,
- [025] Fig. 7, 8, 9 example series of gear ratios for a transmission in accord with Fig. 1,
- [026] Fig. 10, 11 example series of gear ratios for a transmission in accord with Fig. 2, and
- [027] Fig. 12 a flow diagram for a transmission in accord with the invention.

[028]

[029]

A transmission (1) (Fig. 1) in accord with the invention is essentially comprised of the spider mounted planetary sets 2, 3, 4 as well as the brakes 5, 6, 7 together with the two clutches 8 and 9. The planetary sets are composed of respectively, a sun gear, a spider support system with planetary gears as well as an internal gear, which sets essentially can be assembled in two different versions. In a first version, the planetary sets are assembled together as follows: the input drive shaft 10 is continually connected to the sun gear 16 of the second planetary set 3. This input drive shaft 10 can be connected, by means of the first clutch 8, with the sun gear 12 of the first planetary set 2 and the said input drive shaft 10, by means of the second clutch, 9 can be connected to the spider of the first

as  
cont, planetary set 2 and to the internal gear 18 of the planetary set 3. This input drive shaft 10 is arranged to be coaxial to the power output shaft 11.

[030] The internal gear 14 of the first planetary set 2 stands continually in connection with the spider 23 of the third planetary set 4 and, in turn, this spider 23 is continually in connection with the power output shaft 11. The following components can be braked against the transmission housing: the sun gear 12 of the first planetary set by means of the first brake 5, the spider 15 of the first planetary set 2 by means of the second brake 6, the internal gear 18 of the second planetary set 3 also by means of the second brake 6, and the sun gear 20 of the third planetary set 4 by means of the third brake 7.

[031] The same components in different Figures or components with the same function are provided with the same reference numbers.

[032] In a further development in accord with the second version of the invented transmission (Fig. 2), again with coaxial input and output drive shafts, respectively 10, 11, the planetary sets 2, 3, 4, the brakes 5, 6, 7 as well as the couplings 8 and 9, essentially, are arranged as before as was shown in Fig. 1. However, this second version differentiates itself from the first version by the means of the interconnection of the individual components.

[033] Thus in this case, the sun gears 12 and 16 of the first and second planetary sets can likewise be connected with, or be in continual connection with the input drive shaft. The power output shaft 11, on the other hand, is in continual connection with the spider 19 of the second planetary set 3 and this, in turn, is in continual connection with the internal gear 14 of the first planetary set 2. The spider 15 of the first planetary set 2 is further continually connected with the internal gear 22 of the third planetary set 4 and the internal gear 18 of the second planetary set 3 is continually connected to the spider 23 of the third planetary set 4. The spider 15 as well as the internal gear 22 can be, in this way, by means of the brake 6, attached to the transmission housing, as can the sun gear 20 by means of the brake 7.

[034] The design of the transmission in accord with Fig. 3, represents, essentially, the first version shown in Fig. 1. In this case, however, the alternative is, that the

input drive 10 and the output drive 11 are provided on the same side of the transmission.

[035] A further alternative arrangement of the transmission is shown in Fig. 4, wherein the input power sequences through the transmission by means of the input drive 10 to the sun gear 16 and simultaneously through the clutches 8 and 9 to the sun gear 12 as well as to the spider 15 which connects to the internal gear 18. The output drive 11 is placed in the transmission between the planetary sets 2, 3, 4 and the clutches 8 and 9.

[036] A development of the transmission arrangement based on the first version (Fig. 5), provides, that the input drive be made through a torque converter 24. The turbine wheel of the torque converter 24 is directly connectable with the sun gear 16 of the second planetary set 3, or is connectable by means of the clutches 8 and 9 with the first or second planetary set 2, 3.

[037] A further alternative arrangement of the invented transmission is presented in Fig. 6, showing an integrated start-up brake for a front-end, cross motor setup in a passenger car. The transmission in this case corresponds to a mirror image design of the first version of the transmission as shown in Fig. 1, wherein, however, the input and output drive shafts 10 and 11 respectively, are placed on the same side. Additionally, between an internal combustion engine 25 and the input drive shaft 10 is found a torsion, vibration damper 26. The power output shaft 11 is, by means of an additional gear ratio stage and a differential 27, connected to the drive wheels 28 and 29.

[038] From Figs. 7, 8, 9, the examples of gear ratio series for the invented transmission in accord with Fig. 1, it may be seen, that the gear ratio  $i$  in the first gear lies between 4.84 and 5.70, and the entire stage range  $\phi_{ges}$  lies between 6.32 and 7.34. The ratio  $i$  in the fifth gear is always 1.

[039] For a transmission in accord with Fig. 2, the two examples of gear ratio series (Figs. 10, 11), exhibit a ratio  $i$  in the first gear between 3.83 or 3.87 at an entire stage range  $\phi_{ges}$  of 4.88 to 5.06. The ratio  $i$  in the fifth gear shows likewise 1.00. The fifth gear is, in all ratio series, is designed advantageously as direct gear.

[040] From the flow diagram of shifting in accord with the presentation of Fig. 12, it may be seen that in the case of sequential shifting, double shifting is avoided, since two neighboring gear stages always employ one switching element in common. From this flow diagram in Fig 12, one can also see, that in the case of any optional shifting between the first and fourth gears, as well as between the fourth and sixth gears, at any time, only one switching element is activated. The shift position of a braked neutral is possible through the activation of the brakes B1 and B2, whereby a blockage of the output drive is made and a simultaneous, defined speed of rotation can be achieved in the transmission, possibly useful for a hill-holding function.

[041] At the same time, free wheeling at each position of the transmission can be brought about, thus, for instance, between the shaft and the housing, or between two shafts, in order to divide one shaft into two. A neutral position can be effected by the closure of one shifting element and the opening of another, for instance, by closing the first brake 5 and opening the second brake 6 for a neutral position forwards.

[042] Further, the input drive shaft 10 can be separated from the motor by a clutch element, whereby the clutch element, for instance, can be designed as a dry or wet start-up clutch, a magnetic powder clutch, a centrifugal, a hydrodynamic clutch or a similar clutch device. Further, the input drive shaft 10 can also be separated from the motor by means of a conversion element, wherein this may be designed as a hydrodynamic converter, as a differential converter, as a start-up retarder, as a hydrostatic transmission, or an electrical transmission or again as an electrodynamic clutch.

[043] Further, the input drive shaft 10 can also be separated from the motor by a conversion element, wherein this could be designed as a hydrodynamic converter, as a differential converter, as a start-up-retarder, as a hydrostatic transmission, as an electrical transmission or as an electro-mechanical transmission or the like. This means, that between the motor and the drive, an additional ratio stage with a constant or even a variable ratio which was equal to or greater than one.

- [044] Alternatively, a start-up element can also be placed behind the drive, so that the input shaft 10 is firmly bound with the clutch shaft of a motor. In such a case, the start-up is carried out by a shifting element of the transmission, for instance, by means of the second brake 6.
- [045] In addition a slip-free brake, for instance a hydraulic or electrical retarder or the like, can be placed on each shaft, preferably on the input shaft 10 or the output shaft 11.
- [046] Also a power takeoff shaft can be provided for the input power from additional components on each shaft, preferably, however, on the input shaft 10 and the output shaft 11.
- [047] The shifting elements themselves comprise powershift clutches or brakes, such as lamellar clutches, band brakes, conic clutches or the like.
- [048] The shifting elements can, however, be made of form-fit clutches or brakes, for instance dog clutches or synchronization.